

STUDY GUIDE

Aerospace: The Flight of Discovery Chapter 1

Basic Aeronautics

1. The imaginary line running from the leading edge to the trailing edge of an airfoil is called the **chord**.
2. **Camber** is a measure of the amount of curvature of the wing based on the distance of the wing's surface from the chord.
3. **Relative wind** is the airflow produced by the aircraft moving through air.
4. **Angle of attack** is the angle between the chord line of an airfoil and the direction of its encounter with the relative wind.
5. **Angle of incidence** is the angle between the chord line of the wing and the longitudinal axis.
6. **Bernoulli's principle** states that, as the velocity of a fluid increases, its pressure decreases.
7. **Induced drag** is drag that is produced by induced lift being created by the wing. All other drag is **parasite drag**.
8. **Thrust** and **drag** are two forces of flight that oppose each other.
9. **Thrust** is a force produced by the engine and propeller (or jet engine) that pulls (pushes) the aircraft forward through the air.
10. **Drag** is a force produced by the friction of air molecules rubbing against the outer surfaces of the aircraft (**skin-friction drag**), by air turbulence caused by irregularities in aircraft shape (**form drag**), and resistance to forward motion caused by induced lift (**induced drag**).
11. The physics definition of **Energy** is the capacity to do work and overcome resistance.
12. An **airfoil** is any part of an airplane that is designed to produce lift.
13. The pressure of the air impacting against the lower surface of an airfoil produces **dynamic lift**.
14. **Induced lift** is produced by the difference in air pressure between the bottom of the airfoil and the top. This difference in air pressure is explained by the Bernoulli principle that states that a faster moving fluid exerts less pressure against its surroundings than a slower moving fluid.

Aircraft Motion and Control

15. **Basic flight maneuvers** consist of turns, climbs, and descents. The stall is not a basic flight maneuver.
16. The axis of an aircraft that runs from wingtip to wingtip is the **lateral axis** (sometimes called the pitch axis).
17. The axis that runs the length of the aircraft fuselage is called the **longitudinal axis** (sometimes called the roll axis).
18. The axis that runs vertically through the center of gravity (when the aircraft is in level flight) is called the **vertical axis** (sometimes called the yaw axis).
19. The point on an aircraft where all the weight is considered to be concentrated is called the **center of gravity**.
20. Roll about the longitudinal axis is controlled by the **ailerons**.
21. The **elevator** controls the up-and-down motion of the aircraft's nose (motion about the lateral or pitch axis).

Aircraft Structures and Instruments

22. An aircraft has five major parts: the fuselage, the wings, the empennage (tail assembly), the landing gear, and the power plant.
23. The **vertical stabilizer** is a fixed part of the empennage (tail assembly) on an aircraft and prevents the aircraft from yawing back-and-forth.
24. The **rudder** is part of the empennage (tail assembly) on an aircraft and controls aircraft motion about the vertical (yaw) axis.
25. There are five types of stress on aircraft structures: tension, compression, torsion, shear, and bending.
26. **Tension** is a type of stress that acts to pull things apart. The stress on a rope being used to pull something is tension stress. If the tension on the rope is continuously increased, the rope will eventually pull apart.
27. **Compression** is a type of stress that acts to push things together. The stress on a vertical column holding up a bridge is compression stress.
28. **Torsion** is a type of stress that is caused by twisting or rotation of a material.
29. **Shear** stress is caused by forces tending to slip or slide one part of a material with respect to another part of the material. The act of tearing a sheet of paper is an example of shear stress.

- 30. An aircraft with **conventional landing gear** has two main landing gear (wheels) and a third small wheel at the tail. An aircraft with **tricycle landing gear** has two main landing gear and third wheel, which is usually steerable with rudder pedals, under the nose.
- 31. Very large aircraft such as the B-52 bomber typically use **tandem landing gear**.
- 32. The **wings** are composed chiefly of spars, ribs, and stringers and are covered with a smooth material (skin). The structures in the wing that support the covering material and give the airfoil its shape are the **ribs**.
- 33. Most modern aircraft have a **semimonocoque** fuselage structure.
- 34. The **vertical speed indicator** tells the pilot whether the aircraft is climbing or descending and the rate at which the aircraft is climbing or descending, in feet per minute.
- 35. The **airspeed indicator** tells the pilot the speed of the aircraft through the air.
- 36. The **attitude indicator** shows the relationship of the horizon to the pitch of the aircraft and the bank of the aircraft's wings.
- 37. On the **Celsius scale**, water freezes at 0 degrees.
- 38. On the **Fahrenheit scale**, water freezes at 32 degrees.
- 39. **Relative humidity** is the ratio of the amount of water vapor in the air to the amount of water vapor the air can hold when saturated.

Aircraft Propulsion

- 40. The major components of a reciprocating engine are: cylinders, pistons, spark plugs, magnetos, carburetor, crankshaft, and engine block/crankcase.
- 41. During the **power stroke** and the **compression stroke** of a reciprocating engine, both the intake valves and the exhaust valves are both closed.
- 42. During the **intake stroke**, the intake valve is open and the exhaust valve is closed.
- 43. During the **exhaust stroke** the intake valve is closed and the exhaust valve is open.
- 44. The primary function of an aircraft engine's **lubrication system** is to reduce friction between moving metal parts. Some of the secondary functions of the lubrication system are to seal various clearances (bearings and piston rings) in the engine, help cool the engine, and clean the engine.
- 45. In a reciprocating engine, the **pistons** are attached to the **crankshaft** by **connecting rods**.

- 46. During the **intake stroke** of a four-stroke reciprocating engine the fuel and air mixture enter the combustion chamber.
- 47. The main advantage of a **fuel injection** system over a **carburetor** is that it eliminates most icing problems associated with carburetors.
- 48. The **ignition system** in a reciprocating aircraft engine is actually a double system with two magnetos, two distributors, and two spark plugs for each cylinder.
- 49. Most reciprocating aircraft engines are **air cooled** rather than water-cooled.
- 50. In an aircraft ignition system, the spark for ignition is produced by the **spark plug**. The **magneto** produces the electrical voltage that causes the spark plug to produce the spark.
- 51. The **carburetor** is the part of a reciprocating engine that mixes aviation gasoline and air together in the most desirable combination for ignition and burning.
- 52. One advantage of a **turbofan engine** over a **turbojet engine** of the same thrust rating is that the turbofan engine is quieter.
- 53. The **turboprop** engine combines the best features of turbojet and propeller aircraft.
- 54. A **propeller** creates thrust the same way a wing creates lift. It is shaped like an airfoil.

Navigation Principles

- 55. Navigation requires the accurate measurement of **time, distance, and direction**.
- 56. Navigating by reference to visible landmarks is called **pilotage** navigation.
- 57. **Dead-reckoning** navigation is accomplished by flying a magnetic heading for a calculated period of time to reach a destination. The magnetic heading and time enroute are calculated by applying wind corrections to magnetic course and distance measured from an aeronautical chart. Dead reckoning uses true course, magnetic course, distance between points, aircraft true airspeed, and wind direction and velocity to calculate magnetic heading, groundspeed, and estimated time enroute. Altitude is not a factor in dead reckoning. The wind at a particular altitude is a factor but not the altitude itself.
- 58. Aircraft flying in FAA controlled airspace normally operate on three-dimensional “air highways,” which are depicted on air navigation charts and are called **airways**. The low altitude airways below 18,000 feet above mean seal level are called **victor airways**.
- 59. An airport that is used by both civil aviation aircraft and military aircraft is a **joint-use airport**.
- 60. Very high frequency radio beams that extend out from VOR stations like spokes on a wheel are called **radials**.

61. When you navigate using the VOR system, you first tune your receiver to the proper VOR station using the frequency selector.
62. When flying in or through controlled airspace, you are subject to control by FAA air traffic controllers.
63. When the temperature of air increases, its **density** will decrease.
64. The direction measured from true north that an airplane flies from its origin to its destination is called **true course**.
65. The direction measured from magnetic north that an airplane flies from its origin to its destination is called **magnetic course**.
66. The direction measured from magnetic north that the pilot points the airplane to make it track along the magnetic course is called **magnetic heading**.
67. In the Earth's reference system, the lines that run north and south from the poles are called **lines of longitude** or **meridians**. The **0° meridian** (also known as the **prime meridian**) passes through Greenwich, England.
68. The most commonly used aeronautical chart is the **sectional chart**, which is made by conical projection from the globe.
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70. On a sectional chart, relief (differences in the ground elevation) is shown by different color tints.
71. The compass error that is caused by the magnetic north pole and the geographic north pole being located at different places is called **magnetic variation**.
72. If an airport has a control tower, the sectional chart will indicate it with a dark blue disk.
73. **Aviation time** is expressed as a four digit number using a 24-hour clock system. For example 11:55 AM becomes 1155 hours. Time after 12:59 PM does not restart at 1:00 PM—but becomes 1300 hours. The time 8:45 PM becomes 2045 ($1200 + 0845 = 2045$)